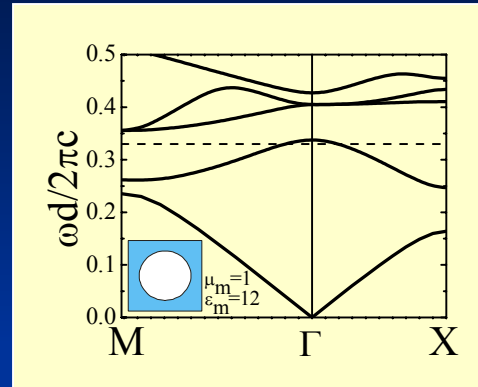


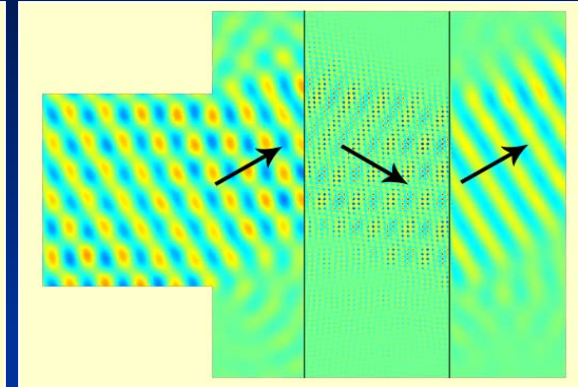
Dielectric photonic crystals as left-handed materials.

Professor Alexei L. Efros, University of Utah, DMR-0102964

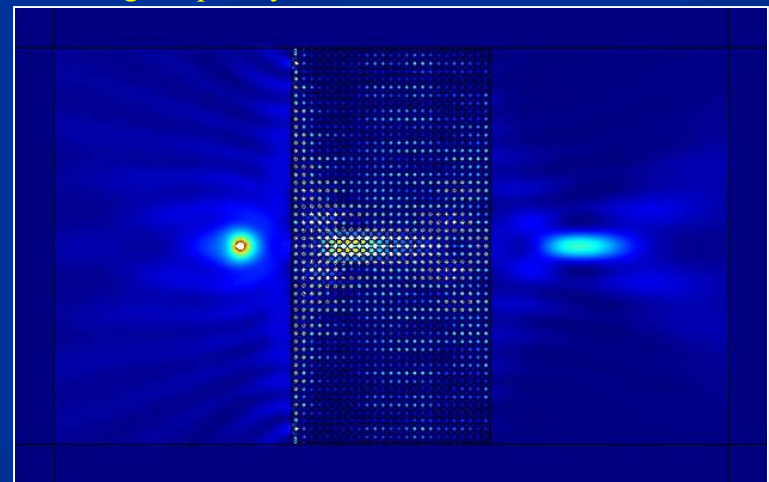
What is a left-handed material (LHM)? In a regular material (RM), the electric permittivity ϵ and magnetic permeability μ are both positive at some frequency. If we can make a material with the same magnitude of ϵ and μ but with negative values at the same frequency, we shall have an LHM that dually corresponds to the RM. The electromagnetic field in the LHM, however, propagates backwards in time, like a movie playing in reverse. Why do we need it? A slab of LHM imbedded into a corresponding RM makes a lens that can produce three-dimensional images due to negative refraction at the interfaces. We propose to make an LHM from a dielectric photonic crystal that has significantly lower losses compared to their metallic predecessors.



Spectrum of 2D photonic crystal with the elementary cell shown in the left bottom inset. Dashed line shows the working frequency.



Computer simulation of the negative refraction of light by a slab of photonic crystal



Simulation of the lens made of a slab of photonic crystal. A point source on the left produces an image on the right of the slab.

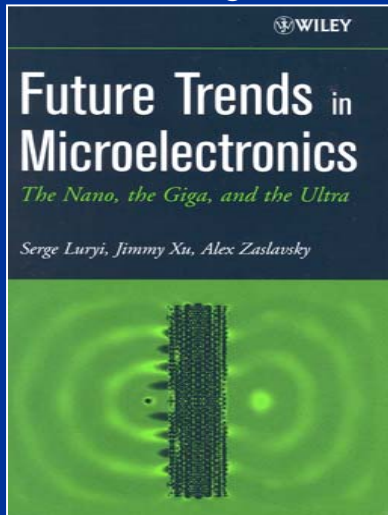
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Broad Impact:

Our papers are published in *Phys. Rev. Letters* (89, 093901-2002; 92, 119401-2004), *Phys. Rev. B* (65, 045110-2002), *Physica B* (338, 333-2003), *Solid State Communications* (129, 643-2004; 124, 283-2002).

Numerous talks have been given at national and international conferences. Proceedings of the FTM Conference published the picture of our lens on the cover page. The post-doctorate member of our group, Alexander Pokrovsky, together with representatives of two other groups gave a Press-Conference at the APS March Meeting 2003.



Cover page of the FTM proceedings, Wiley 2004.

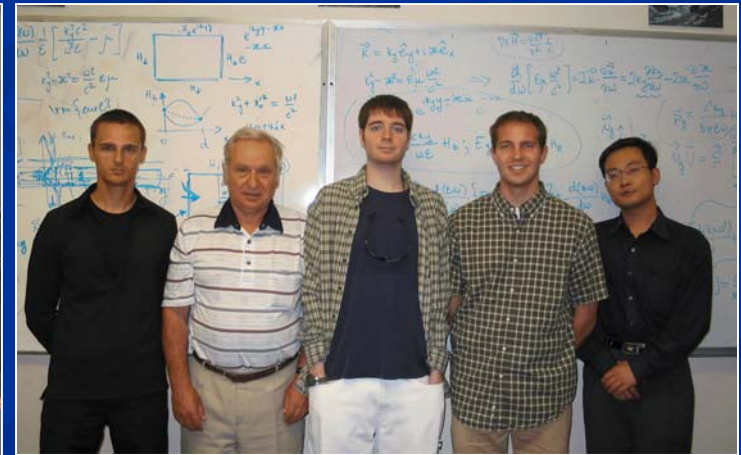


A. Pokrovsky gives a presentation at the Press-Conference of the APS March Meeting 2003 on left-handed materials.

Young scientists learn the magnificent new developments in electrodynamics. They are dealing with a new generation of software able to solve very difficult problems.

Education:

One postdoctoral research associate (our former student) Alexander Pokrovsky, two graduate students, Chengyu Li and Joshua Holt, and one undergraduate student, Shai Vardeny are involved in this project.



Theoretical group of DMR-0102964.